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RESEARCH PAPER

Designing business model taxonomies – synthesis and guidance from information systems research

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Abstract
Classification is an essential approach in business model research. Empirical classifications, termed taxonomies, are widespread in and beyond Information Systems (IS) and enjoy high popularity as both stand-alone artifacts and the foundation for further application. In this article, we focus on the study of empirical business model taxonomies for two reasons. Firstly, as these taxonomies serve as a tool to store empirical data about business models, we investigate their coverage of different industries and technologies. Secondly, as they are emerging artifacts in IS research, we aim to strengthen rigor in their design by illustrating essential design dimensions and characteristics. In doing this, we contribute to research and practice by synthesizing the diffusion of business model taxonomies that helps to draw on the available body of empirical knowledge and providing artifact-specific guidance for building taxonomies in the context of business models.

Keywords Taxonomy · Business model · Classification · Literature review · Business model taxonomy

JEL Classification A10

Introduction

Business models tell the story of how a business works (Magretta, 2002). Compelling business models are of great importance to achieve sustainable advantages as well as help novel technologies, products, and services to achieve economic success (Chesbrough, 2010; Gambardella & McGahan, 2010). To make the complexity of a business model more graspable, classification approaches can be employed that provide distinguishable business model types (Baden-Fuller & Morgan, 2010; Kamprath & Halecker, 2012; Lambert, 2006b), enabling analyzing and developing business models (Lambert, 2015; Lund, 2013). So-called *business model taxonomies*[1] are among the dominant forms of such classifications (Nielsen et al., 2018) that have high merit for theory and practice because they allow for advancing scientific understanding and enable finding new combinations and stimulating innovation (Lambert, 2015; Paukstadt et al., 2019b; Remane et al., 2016). These taxonomies respond to the need to create an empirical understanding of how the business model concept itself is used and how business models work, demanding "real-life examples to study" (Baden-Fuller & Morgan, 2010, p. 163). To do so, they act as storage systems for empirical knowledge about business models (Lüdeke-Freund et al., 2018; Rich, 1992).

However, the specifics of designing empirical classifications of business models are an under-researched field that require structure and rigor (Fielt, 2013; Groth & Nielsen, 2015; Lambert, 2015). While there have been studies investigating empirical research in business models, to the best of our knowledge, there are no studies that explicitly analyze the phenomenon of business model taxonomies (Lambert & Davidson, 2013), leaving the aforementioned potentials for business model design rather untapped. To bridge this gap, this study focuses on two areas, namely (1) the diffusion of business model taxonomies with regards to the industry

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[1] Being aware of authors differentiating between classification types (e.g., Bailey (1994)), this paper follows business model literature that uses *taxonomy* as empirical classifications and *typology* as conceptual classifications (e.g., Lambert (2015)).

and/or technology and (2) options for the design of such taxonomies. Next, both areas are described in more detail.

Visualizing taxonomies as *morphological fields* allows making conclusions about the *Gestalt* of the phenomenon, i.e., its configuration (Ritchey, 1998). Thinking in configurations is valuable for business model design because most business models recombine available patterns (Gassmann et al., 2017). For this reason, corresponding configurations (i.e., taxonomies) should be available for many design situations. To this day, we observe that business model taxonomies emerge from different technologies and in domains as diverse (DaSilva & Trkman, 2014; Zott et al., 2010, 2011), such as *mobility* (Lembcke et al., 2020; Remane et al., 2016), *logistics* (Möller et al., 2020), and *FinTech* (Eickhoff et al., 2017). Thereby, other established industries, like fashion and automotive, lack empirical analysis in the form of taxonomies. However, understanding business models and leveraging their potential across industry and technology is a vital issue for economic success, as “a better business model will often beat a better idea or technology” (Chesbrough, 2007, p. 12). In domains not addressed by taxonomies, academics and practitioners are less supported in getting inspiration and possible configurations from available best practice examples. Since the business model has both high utility in general and a focus on an industry-scale (Groth & Nielsen, 2015), we asked: *What is the diffusion of business model taxonomies in terms of industrial sectors and technologies? (RQ1)*

In addition to the heterogeneity of domains and technologies addressed, we can observe an inconsistent way of how such taxonomies are designed, indicating a need for further methodological guidance. Generally, business model taxonomies vary across context-specific (design) dimensions, which, if carefully analyzed, advances the understanding of how they should be created (Fielt, 2013). As those taxonomies are an emerging artifact and of high importance for business model research (Groth & Nielsen, 2015; Lambert, 2015), we propose a meta-study that examines current practices to guide their future design. Accordingly, we asked: *How to guide the design of business model taxonomies? (RQ2)*

In pursuing to answer our RQs, we perform two main phases. Firstly, based on a literature sample, we extract design options and examine how researchers build business model taxonomies to guide the future design of this type of taxonomies. Secondly, we show industries and technologies addressed in our sample to quantify the current degree of the taxonomy’s coverage and identify white spots for future research endeavors.

The article is structured as follows. Next, we illustrate the background of business models and taxonomies. We afterward explain our research design, consisting of a structured literature review and a taxonomy development. Based on this, we present our design variables for business model taxonomies. We then discuss the results and identify implications for the broader field of business model taxonomies and reflect on their design's best practices. Lastly, we highlight contributions, state limitations, and illustrate avenues for further research.

Background

Business models

Business models have become a viable object of interest in IS (Veit et al., 2014) and in-company practice (Casadesus-Masanell & Ricart, 2011). Although the term business model is occasionally entwined with adjacent terms (Gordijn et al., 2000; Seddon et al., 2004), it is located at the intersection of the higher-order *business strategy* and the operationalizable *business processes* (Al-Debei & Avison, 2010; Al-Debei et al., 2008). Despite a rich body of literature, there is still no standard definition of the business model concept (Burkhart et al., 2011); Teece (2018, p. 41) even argues that there are so many definitions “of a business model, as there are business models.” Subsequently, researchers list and compare several definitions (e.g., Zott et al. (2010) or Fielt (2013)) and business model components (e.g., Morris et al. (2005) or Shafer et al. (2005)).

Despite having no single definition, the business model concept can have three major interpretations (Massa et al., 2017). Firstly, business models as a ‘cognitive/logistic schema’, which presumes that managers do not hold systems in their minds when they make decisions but images of such systems shaped by their own cognitive frames. Secondly, business models as ‘formal conceptual representations’. In contrast to implicit and unspoken schemas, business models are explicated to articulate the complexity of business logic. This interpretation understands a business model as a conceptual blueprint of the company’s logic (Amit & Zott, 2001; Osterwalder et al., 2005). Here, the *business model canvas* (Osterwalder, 2004; Osterwalder & Pigneur, 2013) enjoys widespread recognition (Spieth et al., 2014). Thirdly, business models as ‘attributes of real firms’. In this interpretation, business models are seen as empirical phenomena or attributes determined “by empirically classifying real-world manifestations of organizations” (Massa et al., 2017, p. 76). That can be supported by, for instance, business archetypes and concepts like ‘freemium’ business models. In this study, we focus on the third interpretation in particular because this allows understanding how firms do business and support the design of business models utilizing empirical attributes and archetypes.

In recent years, the business model literature has shifted to analyzing *digital business models* that primarily build upon digital technologies (Bock & Wiener, 2017; Dos Santos et al., 2014; Otto et al., 2015; Veit et al., 2014). For example, *data-driven business models* explicitly leverage data as the key resource (Hartmann et al., 2016; Schüritz et al., 2017), and *platform business models* focus on generating network effects (Asadullah et al., 2018; Giessmann & Legner, 2016). These exemplary developments illustrate the demand for understanding new (digital) business models and their underpinning fast-evolving technologies, which can be supported by empirical taxonomies.

Business model taxonomies

Business model classifications – taxonomies, typologies, types, and patterns – are an integral part of business model research (Gassmann et al., 2017; Osterwalder et al., 2005; Pateli & Giaglis, 2004). Typically, business model classifications produced *deductively derived typologies* that did not have an empirical basis but sought to formulate idealized types of businesses (Baden-Fuller & Morgan, 2010; Lambert, 2006a, 2015). Following Weber (1949), idealized types refer to a high abstraction of detail, then to distinguish between detailed empirical objects. Hence, the first business model classifications only covered a few dimensions, often two, and created descriptive labels (e.g., Timmers (1998), Rappa (2004), Kamoun (2008)).

A body of literature on business model taxonomies has emerged that predominantly leverages *empirical data to generate taxonomies* of business models and analyze them more intensively by developing *clusters* and *archetypes*. For instance, Remane et al. (2016) identify car-sharing business models, clusters, and archetypical patterns; Eickhoff et al. (2017) did this for FinTech start-ups (for an overview of business model taxonomies, see Appendix 1). Often, these business model taxonomies gather data using publicly available data sources via *desk research* based on the notion that "(…) business model elements are often quite transparent and (in principle) easy to imitate (…)" (Teece, 2010, p. 179). The clusters host individual business models that are highly similar to each other yet, highly dissimilar to business models in different clusters. They are the foundation to identify business model patterns, which are reoccurring configurations to solve reoccurring problems (Rudtsch et al., 2014). Rather than being merely descriptive, the purpose of patterns is to help their users design new business models and break cognitive barriers (Remane et al., 2017b). Patterns that implicate foundational configurations, i.e., those that are representative and used for imitation, are *archetypical patterns* or *archetypes* (Johnson, 1994), which, in business models, are highly representative examples (Fielt, 2013). Our analysis shows that there are numerous ways to develop business model taxonomies that diverge in method, visualization, and other design parameters, which motivates this study's systematic inquiry to support business model taxonomy design.

Research design

In line with our overall goal of providing a sound overview of available business model taxonomies and guide their future design, two phases are performed, namely (1) reviewing the literature to obtain a sample of empirically derived business model taxonomies and (2) examining options for business model taxonomy design.

Phase 1: structured literature review

To obtain empirical data, we conducted a structured literature review by following the guidelines of Webster and Watson (2002) (see Appendix 4 for details). We define the literature search scope for articles presenting business model taxonomies as their contribution or articles dealing with the conceptual underpinnings. The latter objective requires a backward search, as these types of articles are usually referenced in papers presenting corresponding taxonomies. Based on this, we constructed a nexus of literature that we divide according to taxonomy building approaches (i.e., *conceptual-to-empirical* or *empirical-to-conceptual* iterations). We used common databases in IS research, i.e., *AISeL*, *Scopus*, and *Google Scholar*. Although an obvious limitation of the review is that one might miss an article (Webster & Watson, 2002), we strived for an exhaustive sample for taxonomy building (Cooper, 1988) with the following filtering criteria. To ensure the inclusion of quality papers, we aimed for *VHB*[2] ranked journals and conference proceedings in IS (Weking et al., 2020a). Thus, we included *ECIS, ICIS, PACIS, AMCIS, WI*, and *HICSS*. We made exceptions to that paradigm if *VHB* does not cover high-quality papers but fits through the scope, quality, and method (e.g., Thiebes et al. (2020)).

Additionally, we only considered papers that produce business model taxonomies in a non-trivial way and provide sufficient, transparent information about their design and results. Predominantly, we focus on the term *taxonomy* to gather empirical classifications (see above). Subsequently, we do not include papers in our sample that do not explicitly reference empirical or literature-based taxonomy design, e.g., mainly qualitatively designed morphologies (e.g., Azkan et al. (2020b) or Labes et al. (2015)). Lastly, we opted only to include peer-reviewed literature in journals and conference proceedings (Levy & Ellis, 2006) and one book publication (Nagel & Kranz, 2020; Nagel et al., 2019).

[2] https://www.vhbonline.org/vhb4you/vhb-jourqual.

Table 1 Overview of literature search

Search String	Database	Results	Included
"Business Model Taxonomy" OR "Business Model Classification"	AISeL (Title and Abstracts)	66	14
TITLE-ABS-KEY ("business model" AND "Taxonomy")	Scopus (Title and Abstracts)	251	24
	Final Sample (no duplicates, filtering, forward & backward search*)		$\sum = 31^{1}$

See Appendix 1 for entire sample

Table 1 summarizes databases, search terms, and the final sample resulting from the *forward & backward search*. We used *Google Scholar* to cross-validate our findings and for backward and forward searches. We stopped our literature review as soon as all researchers (having researched each database individually) could not find additional articles (Leedy & Ormrod, 2014; Randolph, 2009).

We excluded papers that did not fit this study's scope: Purely conceptual papers (see Lambert (2006a), Lambert (2006b), Lambert (2015), Lambert and Davidson (2013), Groth and Nielsen (2015), or Kamprath and Halecker (2012)); papers with a different focus, such as taxonomies for business model development tools (see Szopinski et al. (2017) or Szopinski et al. (2019a)), classifications of literature (see Burkhart et al. (2011)), taxonomies with other analytical objects (see Berger et al. (2018) or Hanelt et al. (2015)) or other classification types (see Endres et al. (2019), Breitfuss et al. (2019), or Abdollahi and Leimstoll (2011)).

The resulting sample (from 2010 to 01/2021) shows a substantial increase in publications on business model taxonomies since 2016; between 2010 and 2015, there was only one empirical business model taxonomy. Since 2016, each year either produced more or the same number of business model taxonomies than the previous one, indicating a rise in interest. 2020 is the peak year for publications proposing business model taxonomies. Figure 1 shows each publication outlet and the corresponding number of publications relevant to this study. Most taxonomies (n = 23) originate in IS outlets (ICIS, ECIS, HICSS).

Two researchers and one research assistant independently analyzed each paper by constructing a concept matrix (Webster & Watson, 2002) and discussed their findings in regularly scheduled meetings. The final matrix is a product of consensus. The papers varied in transparency and information; thus, determining some dimensions required judgment (Saldaña, 2015; Sipe & Ghiso, 2004). For example, we manually analyzed the taxonomy and agreed on a categorization if the papers did not indicate whether characteristics are mutually exclusive.[3]

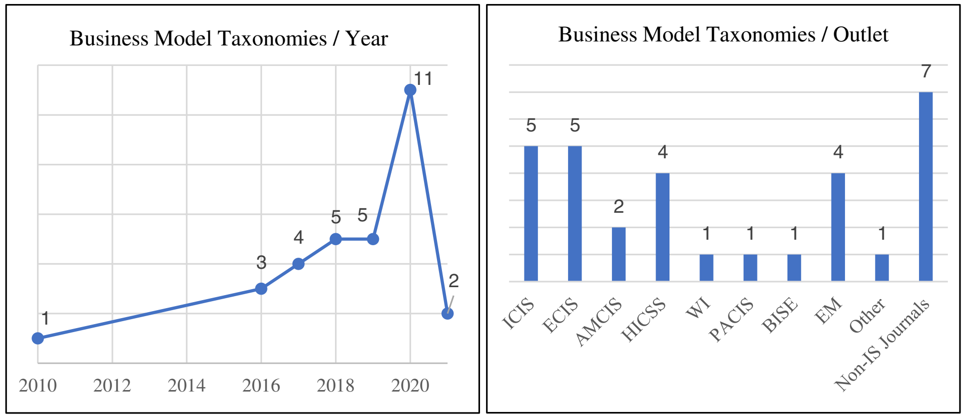
Phase 2: taxonomy building and evaluation

To derive design options for business model taxonomies, this study follows the de facto standard in taxonomy development, the method of Nickerson et al. (2013), which replaced prior existing ad hoc-approaches (Oberländer et al., 2019; Szopinski et al., 2019b). As the first step, one must determine a *meta-characteristic*, which is both the superordinate purpose of the taxonomy and the ultimate starting point from which all subordinate elements must be derived. In our case, the meta-characteristic reads as follows: Provide design options that guide future development of business model taxonomies (purposes); designers of business model taxonomies, practitioners, and academics interested in business model classifications (target group).

Afterward, ending conditions need to be specified, which terminate the iterative taxonomy building process. Nickerson et al. (2013) recommend five subjective ending conditions and eight objective ending conditions that we adopted in our building process. In the next step, approach, one must choose between either following the *conceptual-to-empirical* or *empirical-to-conceptual* path to generate/revise a taxonomy. The *conceptual-to-empirical* approach mirrors essentialist, deductive reasoning in finding dimensions and characteristics, while the *empirical-to-conceptual* approach relies on inductive, empiricist rationales (Lambert, 2015). Finally, the process is repeated until the designer reaches theoretical saturation, i.e., until no taxonomy manipulation is necessary (Appendices 2 and 3).

[3] Other = Book publication of Nagel and Kranz (2020).
Non-IS Journals: International Journal of Production Economics, Journal of Medical Internet Research, European Management Journal, Journal of Business Strategy, International Journal of Innovation Management, International Journal of Operations & Production Management.

Fig. 1 Distribution of papers across years (left-hand side; collection ended in 01/2021) and outlets (right-hand side)



ICIS = International Conference on Information Systems, ECIS = European Conference on Information Systems, AMCIS = Americas Conference on Information Systems, HICSS = Hawaii International Conference on System Sciences, WI = International Conference on Wirtschaftsinformatik, PACIS = Pacific-Asia Conference on Information Systems, BISE = Business & Information Systems Engineering, EM = Electronic Markets.

Taxonomy building – iterations (Approach)

The taxonomy in this study required three iterations to reach its final state (see Table 2). In the 1st iteration, we chose the *conceptual-to-empirical* approach and strived to identify conceptual underpinnings that could give us initial dimensions and characteristics. Secondly, as our final sample contains 31 papers presenting business model taxonomies, we divided it into 16 papers for the 2nd iteration and 15 papers for the 3rd iteration. The 2nd iteration is *empirical-to-conceptual*, which we use to develop the conceptually derived initial dimensions and characteristics. The 3rd iteration, also *empirical-to-conceptual*, completes the full analysis of the sample.

1st Iteration: The basis for determining initial conceptual dimensions and characteristics is the foundational literature on business model taxonomies and taxonomies in general. Therefore, we create a literature corpus consisting of (1) papers that report on original business model taxonomies (e.g., Remane et al. (2016) or Paukstadt et al. (2019a)) and (2) papers that discuss their theoretical underpinnings either focused on business model taxonomies or taxonomies in general (e.g., Lambert (2015), Groth and Nielsen (2015), or Glass and Vessey (1995)). As a result of this analysis, we could identify a set of relevant elements.

For example, Glass and Vessey (1995) discussed that a taxonomy must be tailored to a specific purpose or be generally applicable, which has implications for the conceptual broadness of dimensions and characteristics. A mutually exclusive, dichotomous division between either generating a specific or general taxonomy seems sensible for any business model taxonomy (McKelvey, 1978). General taxonomies should be applicable on a broader scale and require more general and abstract characteristics, while specific taxonomies should thematize conceptually narrow characteristics (Glass & Vessey, 1995; Hanelt et al., 2015).

Another example is Lambert's (2015) proposition, which argues for general taxonomies spanning multiple industries that enable the derivation of more generally applicable patterns. Contrarily, Kamprath and Halecker (2012, p. 6) highlight the notion of industry-specific business model classifications, as these allow "(…) greater insights in these particular sectors". Yet, as we can see, looking at seminal articles in the field (e.g., see Hartmann et al. (2016)), there is also merit in generating generic business model taxonomies that do not focus on a particular industry but take a

Table 2 Overview of taxonomy building iterations

Iteration	Approach	Sample	Rationale
1	Conceptual-to-Empirical	-	The literature provides existing knowledge about taxonomies in general and business model taxonomies. For that reason, it is appropriate first to incorporate conceptual knowledge from the underlying literature to achieve both a high degree of rigor and connectedness to theory
2	Empirical-to-Conceptual	16	The dimensions and characteristics defined in the previous iteration are tested against empirical objects, i.e., business model taxonomies from the literature. We divided the sample to have an initial empirical set of objects for design and, at least, a second group to validate the findings against more objects
3	Empirical-to-Conceptual	15	Another empirical-to-conceptual iteration is necessary to test the finding from the 2nd iteration and refine dimensions and characteristics

broad look, at the concept itself. Of course, choosing either path has implications for the degree of generalizability, i.e., either on an industry level or a general, conceptual level (Lambert & Montemari, 2017). However, as both avenues seem reasonable, a dimension for business model taxonomy design should reflect whether it is supposed to be industry-independent or tailored to a particular industry.

Both Szopinski et al. (2020) and Oberländer et al. (2019) highlight that there is a range of visualization options for taxonomies, *morphological fields*, *tables*, *matrices*, *mathematical sets, hierarchies, visual,* or *textual*, which seem suitable characteristics to emerge from the 1st iteration. Additionally, Nickerson et al.'s (2013) method is the de facto standard, which would indicate that it is a central characteristic (Oberländer et al., 2019; Szopinski et al., 2019b). To ensure a dimension's dichotomy, there is a need for providing additional *development methods*.

Summarizing, in the 1st iteration, we deduced dimensions for *visualization*, *depth of analysis*, *industry scope*, and *development method*. In Appendix 5, we provide details of each iteration.

2nd Iteration: The next iteration inductively generates dimensions and characteristics from 16 papers. We could not find an example that visualizes taxonomies as mathematical sets or graphical illustrations in terms of visualization; some authors use *mathematical sets* to explain the development of their taxonomies. Complementarily to industry sectors, papers also focus on specific technologies. We integrated the dimension of *technology scope* that distinguishes between a *technology-centered* or a *generic focus*. If articles visualize the taxonomy as morphologies, they often use meta-dimensions. Therefore, we include the binary status of using *meta-dimensions* in business model taxonomy as a dimension. As an additional development method, we found, for example, Täuscher and Laudien (2017), who use a *numerical approach* to taxonomy design (see Appendix 5).

3rd Iteration: After analyzing the remaining 15 papers, there are no significant taxonomy changes (e.g., changing the name of the dimension *meta-dimension* to *theoretical lens*). We opted to extend the taxonomy's utility and structure by classifying each dimension into a higher-order group of meta-dimensions and order them in a sequence. Usually, these meta-dimensions would act as a conceptual lens that allows the user to analyze empirical data through a specific conceptual framework. In our case, we use meta-dimensions to bring additional structure and clarity into the taxonomy.

We have abstracted four meta-dimensions: *Data* includes all dimensions outlining the underlying object of analysis, how data is collected, how the data is sampled, and whether a theoretical lens for their study is applied. *Development* subsumes dimensions relevant to construct the business model taxonomy structurally. It specifies what method is applied to generate the taxonomy, whether the taxonomy analyzes a specific technology or industry, and the conceptual depth. These dimensions are highly relevant in shaping how the data is analyzed and to what extend the dimensions and characteristics are specific and conceptually narrow or generic and very broad. *Representation* contains dimensions for the taxonomy's visual construction, including the configuration of the visualization style for the taxonomy (e.g., morphological field or hierarchies). Also, it consists of the dimension exclusivity, which describes whether the dimensions have mutually exclusive characteristics. *Analysis* focuses on further processing of taxonomical results. This processing including the dimension *further application* (different outcome based on the taxonomy), *clustering tool*, *clustering algorithm* (e.g., Ward (1963)).

Additionally, in the 3rd iteration, we introduced the notion of exclusivity of characteristics, which we determined for every dimension through discussion amongst the authors. The final taxonomy is as follows:

$T_{Final} = \{$
MD_1 (Data) {

D_1 (Object of Analysis) | C_1 (Start-Ups, Incumbents, No Differentiation) | EX = {N}.
D_2 (Data Collection) | C_2 (Public Data Analysis, Literature Review, Hybrid) | EX = {Y}.
D_3 (Data Sampling) | C_3 (Random, Selective/Comprehensive) | EX = {Y}.
D_4 (Theoretical Lens) | C_4 (Yes, No) | EX = {Y}},

MD_2 (Development) {

D_5 (Development Method) | C_5 (Nickerson et al. (2013), Numerical, MDS, Grounded Theory, Ad Hoc) | EX = {Y}}.
D_6 (Industry Scope) | C_6 (Industry-Specific, Generic) | EX = {Y}.
D_7 (Technology Scope) | C_7 (Technology-Specific, Generic) | EX = {Y}.
D_8 (Depth of Analysis) | C_8 (Narrow, Wide) | EX = {Y}},

MD_3 (Representation) {

D_9 (Exclusivity) | C_9 (Mutual, Partial, None) | EX = {Y}.
D_{10} (Visualization) | C_{10} (Morphological field, Hierarchy, Table/Matrix) | EX = {Y}},

MD_4 (Analysis) {

Table 3 Design options for business model taxonomies and three exemplary applications

MD	Dimensions	Characteristics						MEX
Data	Object of Analysis	Start-Up (45%)	Incumbent (3%)	No Differentiation (52%)				Yes
	Data Collection	Public Data Analysis (35%)	Systematic Literature Review (13%)	Hybrid (52%)				Yes
	Data Sampling	Random (23%)	Selective/Comprehensive (77%)[5]					Yes
	Theoretical Lens	Yes (74%)	No (26%)					No
Development	Development Method	(Nickerson et al. 2013) (84%)	Numerical (6%)	MDS (3%)	Grounded Theory (3%)	Ad Hoc (3%)		Yes
	Industry Scope	Industry-Specific (48%)	Generic (52%)					Yes
	Technology Scope	Technology-Specific (48%)	Generic (52%)					Yes
	Depth of Analysis	Narrow (48%)	Wide (52%)					No
Repres-entation	Exclusivity	Mutual (58%)	Partial (29%)	None (13%)				Yes
	Visualization	Morphological field (71%)	Hierarchy (13%)	Table/Matrices (16%)				Yes
Application	Further Application	Clusters (55%)	(Arche-)Types (61%)	None (32%)				No
	Clustering Tool	R (16%)	SPSS (19%)	None (45%)				Yes
	Clustering Algorithm	AHC (42%)	K-Means (23%)	k-medoïds (10%)	MBR (3%)	Qualitative (16%)	None (39%)	No

(Remane et al. 2016) (Bock and Wiener 2017) (Beinke et al. 2018)

Some dimensions exceed 100% if multiple characteristics could be selected or fall below 100% if not all characteristics could be filled out. MD = Meta-Dimension, MEX = Exclusivity, AHC = Agglomerative Hierarchical Clustering. For a definition of each characteristic, see Appendix 2.

D_{11} (Further Application) | C_{11} (Clusters, (Arche-)types, None) | EX = {N}.
D_{12} (Clustering Tool) | C_{12} (R, SPSS, None) | EX = {Y}.
D_{13} (Clustering Algorithm) | C_{13} (AHC, K-Means, k-medoïds, MRB, Qualitative, None) | EX = {Y}}}

Taxonomy building – ending conditions

Taxonomies, per se, are never finished but can only achieve a satisfactory state in that they are useful in depicting the objects they were meant to show (Bock & Wiener, 2017; Nickerson et al., 2013). We follow standard practice in taxonomy design and use the ending conditions from Nickerson et al. (2013) to indicate the building process's termination and indicate minimum requirements for valid and useful taxonomies. All 31 business model taxonomies could be classified in the final iteration in terms of objective ending conditions. While minor changes were required in the last iteration (e.g., removing characteristics introduced in the 1st iteration, which could not be verified empirically), no significant manipulations were necessary. Additionally, all dimensions and characteristics are unique and occupied by at least one object, ensuring that no dimension or characteristic is redundant or empty. Regarding the subjective ending conditions, we argue that our taxonomy consisting of thirteen dimensions is *concise*. The sheer visual representation is not overwhelming, and the number of dimensions and characteristics is in line with similar taxonomies (Oberländer et al., 2019). The taxonomy is *robust*, as it can be used to differentiate between individual objects, which results, for example, in the creation of Table 3. The taxonomy has a logical flow (see Table 3) and describes the central design variables in the design of business model taxonomies in detail. It is *comprehensive* and *extendible*, as all objects could be classified in the taxonomy, yet, as the iterations show, the extension is intuitive and easy to do. Lastly, our taxonomy is *explanatory* as it describes how business model taxonomies differ and guides researchers as to which design parameters they consider in their designs [4].

Taxonomy evaluation

To further indicate our taxonomy's usefulness in guiding business model designers, we follow Szopinski et al. (2019b) and configure an evaluation according to the *subject*, *object*, and *method.* Thereby, we differentiate between an internal and external part. The first part is an internal evaluation in which the authors analyze the taxonomy's applicability using illustrative examples. All authors have prior experience in designing business model taxonomies. Using examples to illustrates the applicability of taxonomies is a common practice in taxonomy research (e.g., Bock and Wiener (2017) or Remane et al. (2017a)) and design science research (Peffers et al., 2012). We took three sample objects randomly and illustrated how they can be classified with our taxonomy (see Table 3). Subsequently, we can demonstrate that the taxonomy achieves its purpose to classify business model taxonomies.

The second part aims to extend the evaluation beyond the author team to knowledgeable subjects. In line with our primary target group (see meta-characteristic), we held a group discussion with researchers from university and applied research. All five participants have prior knowledge of creating taxonomies. One participant is also knowledgeable in the business models domain and is explicitly familiar with designing business model taxonomies. Each participant was introduced to the taxonomy and an information sheet with definitions of each dimension and characteristic. We split the participants into two groups and asked them to classify four randomly selected business model taxonomies. After both groups had finished, we held a group discussion on the taxonomy's potentials. Issues raised regarded qualitative assessed characteristics. For example, the participants highlighted that the dimension *conceptual depth* should not be mutually exclusive because some taxonomies are not categorizable as either *narrow* or *wide*. The distinction between the dominant approach to collect data was unclear, as the papers varied greatly in their degree of using prior literature. Some papers clearly outline *systematic literature review* approaches, while others shortly indicate that the existing literature corpus influences taxonomy design. Lastly, in the dimension *data sampling,* the participants highlighted that the characteristic *selective/comprehensive* should be split into two different characteristics. We followed that advice, yet, we did not differentiate in our numerical analysis as determining both characteristics in the paper proved to be too blurry. We asked all participants to provide us with feedback on whether the taxonomy would help them design their taxonomies, to which all agreed. Overall, the usefulness for novice researchers to develop (business model) taxonomies was stressed. Finally, the participants highlighted the need to include strategies for evaluation. Yet, following Szopinski et al. (2019b), most papers do not actively evaluate taxonomies. We do, however, not see a taxonomy decision but rather a recommendation to choose suitable evaluation strategies.

Results: design options for business model taxonomies

Table 3 illustrates the final taxonomy for the design of business model taxonomies as a morphological field. We chose that type of visualization because it enables intuitive insights into how such taxonomies work (Ritchey, 1998). Instead of merely classifying taxonomies, we dedicatedly wanted to analyze their design phenomenology, i.e., their forms and possible morphological design configurations (Cross, 1999; Fiedler et al., 1996). Moreover, we structured the design options through higher-order theoretical lenses (Niederman & March, 2019), so-called *meta-dimensions* (see below). These meta-dimensions are ordered according to the potential sequence of building business model taxonomies, starting from obtaining data to applying a (completed) taxonomy.

To provide further guidance on operationalizing the design options, Table 4 outlines key questions that researchers can use while designing their business model taxonomies. Simultaneously, these guiding questions represent our rationales for selecting dimensions and our understanding of them.

Meta-dimension: data

The dimension object of analysis refers to whether authors consider a specific focus for their business model taxonomies (*start-up* and *incumbent firm*) or take a rather holistic view and do not make any differentiation.

Data collection describes approaches to gather the underlying data and thereby differentiates three characteristics for determining business model elements through an empirical analysis of *publically available data*, a systematic review of *literature*, or a *hybrid* approach combining both. The characteristic *hybrid* also includes interviews, which few papers used to collect empirical samples or insights into taxonomy building (e.g., see Passlick et al. (2021)). As it is not a

[4] According to our evaluation, the characteristic should be split into *selective* and *comprehensive*. As it was not possible to identify the exact characteristic in enough papers, we did not split the characteristic in our data sample, yet, recommend for users of our taxonomy to choose one of both approaches.

Table 4 Guiding questions for business model taxonomy design

Meta-dimension	Dimension	Guiding question
Data	Object of Analysis	Which objects does the taxonomy examine?
	Data Collection	What is the approach to collect the data?
	Data Sampling	How are the data sampled?
	Theoretical Lens	Does the taxonomy use a business model framework as a theoretical lens to analyze the data?
Development	Development Method	Which method is used to develop the taxonomy?
	Industry Scope	Is the taxonomy specific for an industry?
	Technology Scope	Is the taxonomy specific for a technology?
	Depth of Analysis	What is the level of conceptual detail of the taxonomy?
Representation	Exclusivity	Are the dimensions mutually exclusive?
	Visualization	How is the taxonomy visualized?
Application	Further Application	Is the taxonomy used for developing clusters and/or archetypes?
	Clustering Tool	Which cluster tool, if any, was used to cluster the data?
	Clustering Algorithm	Which cluster algorithm, if any, was used to cluster the data?

stand-alone characteristic and purely interview-based qualitative taxonomies would be out of our scope, we subsume interviews under *hybrid*. Usually, in the latter case, literature is the starting point to build initial dimensions extended with empirical data in subsequent iterations. If the taxonomy is purely based on literature, there is no additional empirical analysis of business model data.

The dimension data sampling dichotomously distinguishes between a *random* approach (i.e., choosing a random sub-sample of a larger corpus that might be too large to analyze comprehensively) and *selective* sampling (i.e., identifying suitable objects either wholly or representatively). Through our evaluation, the participants suggested that the sampling strategies should be split between *selective* (with selecting criteria) and *comprehensive* (including as many objects as possible).

The dimension theoretical lens indicates whether a taxonomy uses a theoretical lens (*yes*) or not (*no*). Usually, researchers use these in morphological taxonomies to entangle empirical data with conceptual underpinnings. Exemplary frameworks are the *VISOR-Framework* (El Sawy & Pereira, 2013) or the *V^4-Framework* (Al-Debei & Avison, 2010).

Meta-dimension: development

In terms of the development method, taxonomies in IS often rely on Nickerson et al. (2013), a fact that is also illustrated by Szopinski et al. (2019b). In terms of business model taxonomies, 84% of the articles use the method of Nickerson et al. (2013), followed by *numerical* (6%), *grounded theory* (3%), *multidimensional scaling* (3%), and ad hoc (i.e., not unambiguously identifiable) methods (3%).

The dimensions for industry and technology scope emphasize whether the business model taxonomies either focus on a *specific* industry or technology or are rather *generic* (see Table 5 for details).

Depth of analysis describes whether the business model taxonomy aims to produce conceptually *narrow* or *wide* characteristics. For example, in Remane et al. (2016)'s taxonomy of car-sharing business models, they provide intense details, such as explaining how keys are exchanged for vehicle access. Contrarily, other business model taxonomies, e.g., Möller et al. (2019), provide general characteristics, such as what platform type a business model employs. Both have merit in their own right, and one could argue that both the design of specific and general taxonomies is needed to grasp a field of study fully. That notion is supported by Glass and Vessey (1995, p. 65), who state that in taxonomy design, "(…) you must choose between a very specific classification that serves a particular purpose and a more general classification that serves many purposes." Conceptually, one could link general and specific taxonomies to respective business model frameworks, e.g., investigating a general concept such as digital business models (Möller et al., 2019) and, correspondingly, a respective sub-type, such as data-driven business models (Möller et al., 2020).

Meta-dimension: representation

Concerning exclusivity, taxonomies should have *mutually* exclusive characteristics (Nickerson et al., 2013). However, we observe that taxonomies either adhere to or do not adhere to mutually exclusive characteristics. Some authors indicate which dimensions have mutually exclusive characteristics and which do not. For example, Paukstadt et al., (2019a, pp. 8–9) refer to the dimensions of customer segments and monetary value and explain that mutually exclusive characteristics would not "(…) reflect the complexity of all identified BMs and the subsequent information loss would have

Table 5 Business model taxonomy coverage based on our sample

Technology / Industry	Generic	Industry 4.0	Block-chain	Digital Platforms	IoT	Genetic Testing	→
Generic	(Bock and Wiener 2017; Engelbrecht et al. 2016; Ertz et al. 2019; Hartmann et al. 2016; Remane et al. 2017b; Weking et al. 2018a)	(Weking et al. 2018b; Weking et al. 2020b)	(Tönnissen et al. 2020; Weking et al. 2020a)	(Fruhwirth et al. 2020; Perscheid et al. 2020; Staub et al. 2021; Täuscher and Laudien 2017; Wulfert et al. 2021)	(Hodapp et al. 2019)		
Logistics	(Möller et al. 2019; Möller et al. 2020)						
Energy	(Paukstadt et al. 2019)				*WHITE SPOTS*		
FinTech	(Eickhoff et al. 2017; Gimpel et al. 2018)		(Beinke et al. 2018)				
Mobility	(Lembcke et al. 2020; Remane et al. 2016; Remane et al. 2017a)						
Music	(Katsma and Spil 2010)						
Healthcare						(Thiebes et al. 2020)	
Smart City			(Nagel et al. 2019; Nagel and Kranz 2020)				
Manufacturing	(Azkan et al. 2020)				(Passlick et al. 2020)		
↓							

threatened the taxonomy's purpose". Thus, the dimension specifies three choices for exclusivity, namely *mutual*, *partial*, or *none*.

In terms of visualization, our taxonomy reflects common findings that authors vary in how they visualize their results to best possibly fulfill a particular task (Szopinski et al., 2020). The most common visual representation is the *morphological field* with 71% in our data set and an absolute number of 22 of 31 business model taxonomies (see Table 3), followed by *tables/matrices* (16%) and *hierarchies* (13%).

Meta-dimension: analysis

Further application refers to the taxonomy, either being the paper's final product or the basis for additional steps. Our findings suggest that, mainly, authors generate *clusters* based on the taxonomy and, subsequently, *(arche-)types* from the clusters. Thereby, two clustering tools are applied in our sample, the statistical programming language *R* that includes different functions for statistical analysis (e.g., the package *cluster* (Maechler et al., 2019)) and the software *SPSS*. The most popular clustering algorithm in our sample is *agglomerative hierarchical clustering* (usually based on Ward (1963)). Following Punj and Stewart (1983)'s recommendations, some papers apply two clustering algorithms to compare the results to enhance the validity of the clustering. In that case, the authors use *agglomerative hierarchical clustering* and *K-means*. Other, more singularly used algorithms are *k-medoïds* and *multiscale bootstrap resampling* or *qualitative* clustering.

Discussion and lessons learned

Synthesizing the status quo of business model taxonomies

Regarding the diffusion of business model taxonomies (RQ1), we could identify focal industries, technologies, and combinations of research opportunities. We juxtapose the business model taxonomies' industries and technologies to visualize their coverage, intersection points, and white spots (i.e., no taxonomy exists that opens future research avenues). Moreover, it is observable that business model taxonomies usually focus either on an industry or a technology and rarely consider both (see Table 5).

Business model taxonomies store empirical knowledge for reuse (Lüdeke-Freund et al., 2018; Rich, 1992). While we cannot make a general statement about which business model taxonomy is more beneficial, we recommend focusing on the *white spots* disclosed by the *status quo* analysis. Although these white spots provide promising impulses for future avenues, they only give first indications for this. Some combinations of industries and technologies might be more valuable to explore than others. For example, by not aiming to exclude opportunities prematurely, we would expect more business model opportunities for (specific) industry 4.0-technologies in (specific) applications of healthcare than in the music domain. As another example, in contrast to the specific applicability, technologies such as 'digital platform' seem applicable to almost any industry (Reuver et al., 2018). They, therefore, provide possibilities for adaption across domain-specific boundaries. Subsequently, evaluation and ranking of the validity and the potential benefits of each white spot are required. Moreover, the white spots represent a snapshot of our sample, which can be extended over time through additional taxonomies.

Based on that overview, we analyzed how the configurations (i.e., specific or generic) are distributed across our sample. We contrasted technology with industry *foci* and calculated the percent distribution across the sample to make the business model taxonomy coverage more transparent. That analysis results in a 2×2 matrix with four quadrants (see Table 6), which we explain here as follows:

- **Quadrant I** hosts taxonomies specific to industry and technology. Examples are Beinke et al. (2018)'s taxonomy of FinTech start-ups using blockchain or Passlick et al. (2021)'s taxonomy of business models for predictive maintenance (IoT application) in manufacturing industries. The potential of business model taxonomies in this quadrant lies in explicating business model potentials in specific industries with dedicated technologies. Hence, this cluster acts as a cumulative storage that generates more in-depth knowledge for a specific industry or/and technology. Contrary to taxonomies in other quadrants, these business model taxonomies are highly focused and conceptually narrow.
- **Quadrant II** contains taxonomies that analyze a specific industry but are generic in terms of technology. For instance, Remane et al. (2016) and Lembcke et al. (2020) propose industry-specific taxonomies for car- and ride-sharing. In this quadrant, the potential lies in cumulating generic business model research for specific industries independent from technologies. Researchers and practitioners can draw on rich business model knowledge of an industry and contextualize it with any technology.
- **Quadrant III** includes taxonomies specific to technology. For example, taxonomies that are tailored for blockchain business models (e.g., Weking et al. (2020a)) or data marketplace business models (e.g., Fruhwirth et al. (2020)) without referring to a particular industry. This quadrant accumulates empirical business model knowledge for technologies, which can be reused and adapted to specific industries.
- **Quadrant IV** consists of taxonomies that neither focus on a specific industry nor a technology. These taxonomies generate generic knowledge for business models, for example, in developing general types of data-driven business models or patterns (Hartmann et al., 2016; Weking et al., 2018a). In this quadrant, the potential lies in generating general insights about business models that can further develop the core concept without being too narrow in terms of industry or technology.

Overall, gaining more coverage would contribute to the knowledge base on business models – particularly to *descriptive design knowledge* (e.g., what dimensions can be considered when designing a business model). This knowledge serves as an input for further developments, including transforming descriptive into *prescriptive statements* for design and action (Gregor & Hevner, 2013) through *conceptual grounding* (Goldkuhl, 2004) as well as generalizing from empirical to *theoretical statements* (Lee & Baskerville,

Table 6 Numerical juxtaposition of industries and technologies

		Technology	
		Specific	Generic
Industry	Specific	*I* 5 (16,13%)	*II* 10 (32,26%)
	Generic	*III* 10 (32,26%)	*IV* 6 (19,35%)

2012) or deriving additional *types of theory* that demand the basic form of a theory (e.g., taxonomy) as a necessary foundation (Gregor, 2006). As 90% of business models recombine existing patterns, it seems reasonable to identify characteristics for various technologies and industries (Gassmann et al., 2016, 2017).

Furthermore, we can observe commonalities across taxonomies that focus on similar industries or technologies. For example, taxonomies in our sample dealing with the blockchain technology indicate whether the blockchain is *public* or *private* or what type of protocol (e.g., *Ethereum* or *Bitcoin*) is used (Nagel & Kranz, 2020; Nagel et al., 2019; Weking et al., 2020a). They are typically visualized as morphology, draw on selective sampling, and apply a theoretical lens in terms of design. The taxonomies on blockchain differ in their *conceptual depth* (from narrow to wide), *data collection* strategies, and *object of analysis* (start-ups vs. incumbent firms), as well as their availability for *generic* and *industry-specific* purposes. As another example, taxonomies on digital platforms are mostly *generic* and not designed for specific industries. They have diverse strategies for *data collection* and *objects of analysis* and share similarities concerning the usage of a *theoretical lens* and the non-existence of *clusters*. However, while the taxonomies for an industry or technology hold some dimensions, they differ in how they are embedded; to provide more specific guidance on their design, there needs to be a higher diffusion.

Explicitly considering business model taxonomies for technologies is paramount, as the value of technology is dormant until "it is commercialized in some way in some way via a business model." (Chesbrough, 2010, p. 355). Filling the white spots would enrich the empirical body of knowledge about business models with new domains, which is a central goal of business model research (Lambert, 2015). For example, crossing the two design variables, *technology-* and *industry-specific,* allow for intuitive visualization of research opportunities on business model taxonomies. Thus, one can easily distinguish generic taxonomies addressing general business model elements (e.g., data-driven businesses (Hartmann et al., 2016)) and those focusing on industries, technologies, or combinations. Most address technologies and their utilization in business models, like blockchain or digital platforms. In contrast, others focus on specific industry sectors but do not refer to any particular technology.

Guiding the design of business model taxonomies

Also, options for designing business model taxonomies are derived (**RQ2**) that we have conceptually entangled with the underlying literature corpus and grounded through empirically analyzing published business model taxonomies. Next, we reflect on what we have learned from our study, seeking to present best practices and in-depth analysis of business model taxonomy design. One objective is to extend the descriptive character through rationales, argumentation, and recommendations in designing an artifact of the class *business model taxonomy*. By extending the boundaries of description to prescription, we address recent propositions of transforming the descriptive character of taxonomies in IS literature to a prescriptive one (Möller et al., 2021). Following Gregor (2009 p. 7), the underlying mechanism to formulate recommendations is "reflecting upon what has been done". Therefore, we went through each design dimension and formulated learnings that we have gathered from an in-depth study of the taxonomies. We did not consider all dimensions for these recommendations as some are naturally more critical (e.g., the *data collection*). In contrast, others are much more prone to be a result of personal preferences or the availability of tools (e.g., *clustering tools*).

Firstly, two significant lessons learned about the methodological nature of building taxonomies are formulated:

- **Visualize according to your purpose:** Taxonomies differ in how they are visualized (Szopinski et al., 2020). Our study produced three dominant visualizations that are common in business model research. The study did not investigate which visualization authors use to follow a specific goal. Yet, we see a general difference in using *hierarchies* and *morphological fields* or *tables/matrices*. From what we can gather, hierarchies are more natural to assign individual objects to a cluster. Contrarily, morphologies have the purpose of being used to find new configurations of an artifact. Thus, we recommend that authors of business model taxonomies provide argumentative reasoning for choosing a design option.
- **Indicate situational exclusivity of dimensions:** The literature on taxonomies, in general, clearly prescribes that characteristics should or even need to be *mutually exclusive* (e.g., Nickerson et al., (2013, p. 342)). Contrarily, Bailey (1994), Marradi (1990), Glass and Vessey (1995), and Fiedler et al. (1996) refer to mutually exclusiveness regarding the categorization of an object into a class rather than relating to individual characteristics of a dimension. We recommend that business model taxonomy designers should decide on complete, partial, or non-mutual exclusiveness and provide argumentative reasoning for their decision. If mutually exclusiveness is not maintained, authors usually point out that it would not adequately consider the complexity of business models. For example, business model taxonomies contain a dimension for specific revenue models, which, if mutually exclusive, rarely depict reality. Additionally, indicating exclusivity makes it easier for readers to understand it swiftly.

Secondly, we formulate three main lessons learned for the actual content of a business model taxonomy:

- **Draw on start-ups as a rich source of information on digital business models:** A significant number of business model taxonomies analyze start-ups (45%), which has pros and cons. Compared to incumbents with collections of business models (Sabatier et al., 2010), start-ups often employ only one or a few business model(s), reducing the complexity of identifying characteristics. Also, due to the innovative (and often digital) nature of start-ups, they provide rich sources of novel business ideas (Criscuolo et al., 2012; Engelbrecht et al., 2016). The novelty can be attributed to the fact that they follow *green-field* approaches, which are not burdened by pre-existing infrastructure like most incumbent companies (Criscuolo et al., 2012; Hartmann et al., 2016). Contrarily, using start-ups as objects can have shortcomings as they employ high-risk and dynamic strategies, for which reason they might fail early or change their business models frequently (Cantamessa et al., 2018; Hartmann et al., 2016). However, we argue that using start-ups is beneficial regarding content (i.e., novel and digital business models) and the design method (i.e., availability and narrowness of data). Yet, one must consider that incumbent firms often have stood the test of time. Focusing solely on start-ups can bias one's view towards digital business models that can fail rapidly (e.g., because business models of start-ups are usually not proven to be successful). Designers should consider this trade-off when using start-up data or incumbent data.
- **Employ the entire spectrum of conceptual depth:** Arguably, to fully understand a domain of interest, one must leverage the full spectrum of conceptual depth. Thus, both types of taxonomies, i.e., those covering a large variety of business models and those covering only a very narrow range, have individual purposes and work conjointly. A taxonomy with a conceptual frame should subsume various business models that differ in highly general characteristics. Contrarily, a narrow taxonomy should consider a small range of business models and have very detailed, almost atomic characteristics (Möller et al., 2020). In this vein, investigating a domain fully requires broad and narrow conceptual investigation. Each taxonomy would provide value on different levels of abstraction. High-level taxonomies structure a field, per se, and uncover larger scale business model opportunities. Supplementary, low-level taxonomies complement these opportunities with more detailed and more easily implementable design dimensions and characteristics.
- **Consider the power of archetypes:** Archetypes elevate the empirical analysis of business models to abstracted, generalized types that complement the knowledge base through imitable and differentiable patterns (Ritter & Lettl, 2018; Zhang et al., 2019). They enable the differentiation between types of business models and allow for understanding, structuring, and innovation. The dominant mechanism to generate business model archetypes is applying cluster analysis. Thereby, the archetypes are centroids, i.e., the basic patterns at the core of a cluster, enabling differentiation from other archetypical patterns engraved in different clusters (Hunke et al., 2017; Wulf & Blohm, 2020).

Implications and limitations

Overall, our work has several implications for theory and practice.

In business model research, the field of business model taxonomies is relatively young (see Fig. 1), though they are helpful and popularly published. As with every emerging artifact, there is a high variance in how to design them. We aim to contribute to the knowledge base of business model tooling and classification. By illustrating design options, researchers striving to design taxonomies can use our findings to explain their design rationales. Subsequently, our work has intersections with developing business models through canvasses or tools in general (Bouwman et al., 2012). The presented design options can also be used as a basis for creating new tooling, for instance, by prescribing the definition of specific foci in terms of a *technology* or *industry* (Bouwman et al., 2020). Accordingly, our meta-taxonomy supports the formalization of constructing new business models on a meta-level (Alt, 2020). Also, our work supports the accumulation of business models knowledge and their storage in taxonomies, advancing the available knowledge base in this field (Jacob, 2004; Lüdeke-Freund et al., 2018; Muntermann et al., 2015). Beyond illustrating the current state of taxonomies, several white spots and research gaps are highlighted that potentially have implications for further knowledge accumulation, and we extended the knowledge base through potential papers.

Relating to taxonomy research, we have identified several dimensions that stress the potential need for domain-specific taxonomy design. The contribution is similar to adjacent studies proposing novel ways to build taxonomies for a specific purpose – context-specific artifacts, for example, the requirements-driven taxonomy design of Notheisen et al. (2019) or the taxonomy design method of Sarkintudu et al. (2018). Design decisions, like focusing on a broad or narrow level of conceptual analysis, should be explained in any taxonomy. Whereas some dimensions consist of generally applicable design variables that should be transferable to additional domains, other dimensions might require to be adapted domain-specifically.

In terms of practice, our results act as a road map for practitioners, divided into three implications. Firstly, our work gives a generic overview of knowledge about business models for particular industries and technologies. Subsequently, practitioners might use our findings to draw from that rich body of knowledge. It gives them easy access to identify relevant business model taxonomies, which they can use to compare or innovate their own business, as well as helps to select a suitable type of taxonomy (e.g., industry-specific) for a practical problem. Secondly, practitioners can use our research to trigger research in their fields, such as forming *research consortia* with universities, applied research, or other institutions (Österle & Otto, 2010). Particularly in interdisciplinary projects and networks, taxonomies are applied to provide impulses for new spin-offs, to create a (terminological) basis allowing to talk about the same thing, as well as present a snapshot that synchronizes the understanding from practice and research (e.g., Kammler et al. (2020)). Lastly, suppose business model taxonomies are not available in a domain or the required degree of conceptual depth. In that case, one can still draw from business model taxonomies of other fields to inspire potential innovation. For example, business model taxonomies outlining data utilization in logistics or manufacturing industries might pose starting points and learning effects for innovation in domains that are not yet covered (e.g., pharma).

Our study is subject to typical limitations. Concerning building our taxonomy on design options, other dimensions and characteristics might be considered more critical and described at a different level of detail and abstraction. Against this, we performed *ex-post* evaluation episodes to validate the artifact`s usefulness. Moreover, it is a snapshot fixed in time, and new business model taxonomies might have been published since our research has ended. With any literature review, there is also a chance to miss papers. As the papers varied in their detail of transparency, we needed judgment for some characteristics or left them blank in some cases.

Outlook

Empirical classifications capture attributes of real firms that support understanding how firms do business, comparing new/available solutions, getting inspiration through configurable characteristics, and identifying archetypes (Massa et al., 2017). To promote this valuable stream of research, our article presents an overview of the current diffusion of business model taxonomies and methodological guidance on how to design such taxonomies. With this, we provide fertile soil for further research. Firstly, we encourage researchers to fill the outlined white spots (Table 5); a promising avenue covers more technologies and industries (Table 6). Extending the status quo with new technologies (e.g., artificial intelligence) or other industries (e.g., manufacturing and retail) would significantly contribute to the knowledge of business models. Moreover, crosschecking business model taxonomies with industries and technologies will help in uncovering peculiarities. Future research might integrate other analysis parameters since we have examined our sample along the two dimensions for technologies and industries (e.g., specific mechanisms (Vorbohle et al., 2021)). Secondly, since we found that archetypes have great potential to contribute to business model design, further investigation on the interplay between both artifacts, the taxonomy itself, and archetypes that are based on the taxonomy is needed (e.g., in which settings designers are more likely to use which artifact). Thirdly, in case of maturity and availability of taxonomies, researchers are enabled to examine similarities and differences within a particular industry or technology (e.g., mainly rely on start-up data) as well as derive different 'design types' of business model taxonomies (e.g., 'meta taxonomies' that consolidate available taxonomies; e.g., Dehnert et al. (2021)). Fourthly, as a complement to empirical taxonomies, future research can investigate the coverage and intended purpose of other classification types, such as typologies[5] containing theoretical and/or conceptual knowledge. Thereby, research could explore in which situation a specific classification type is best suitable and provide design variables for such classifications in general, which would have broader implications. Also, the underlying empirical database could be extended with taxonomies that originate in practice (e.g., to include expert-driven business model classifications), which could help triangulate our findings. The design options for business model taxonomies can act as the basis to identify evolution potential in business model taxonomies and compare their morphological configuration longitudinally at different points in time, which allows drawing conclusions about the (re-)use and evolution of business model taxonomies.

[5] The authors acknowledge that typologies can be seen as a type of classification (e.g., Fiedler et al. (1996); Bailey (1994) and a form of theory (e.g., Doty and Glick (1994)).

Appendix 1: Sample of business model taxonomies

Table 7 Sample of business model taxonomies

	Literature	Visualization			Conceptual Depth		Industry		Technology		Data Collection			Object of Analysis		
		Morphology	Hierarchy	Table /Matrix	Narrow	Wide	Industry-Specific	Generic	Technology-Specific	Generic	Public data analysis	Literature Review	Hybrid	Start-Up	Incumbent	No differentation
1	Weking et al. (2020a)	x				x		x	x				x		x	
2	Tönnissen (2020)			x		x		x	x				x	x		
3	Thiebes et al. (2020)			x	x		x		x		x					x
4	Weking et al. (2020b)	x			x			x	x				x	x		
5	Möller et al. (2020)	x			x		x			x	x			x		
6	Hodapp et al. (2019)	x			x			x	x				x			x
7	Fruhwirth et al. (2020)	x			x			x	x				x			x
8	Perscheid et al. (2020)	x				x		x	x			x				x
9	Paukstadt et al. (2019)	x				x	x			x			x	x		
10	Ertz et al. (2019)		x			x		x		x			x			x
11	Möller et al. (2019)	x				x	x			x	x			x		
12	Eickhoff (2017)			x		x	x			x	x			x		
13	Weking (2018a)		x			x		x		x		x				x
14	Beinke et al. (2018)			x		x	x		x		x			x		
15	Weking (2018b)	x			x			x	x				x			x
16	Remane et al. (2017b)	x				x		x		x		x				x
17	Remane et al. (2017a)	x			x		x			x	x					x
18	Täuscher et al. (2017)	x				x		x	x		x			x		
19	Bock & Wiener (2017)	x				x		x		x		x				x
20	Remane et al. (2016)	x			x		x			x			x	x		
21	Engelbrecht (2016)		x			x		x		x	x			x		
22	Hartmann (2016)		x			x		x		x	x			x		
23	Katsma (2010)			x	x		x			x			x			x
24	Nagel et al. (2019)	x			x		x		x		x			x		
25	Gimpel et al. (2018)	x			x		x			x			x	x		
26	Nagel et al. (2020)	x			x		x		x		x			x		
27	Azkan et al. (2020)	x				x	x			x			x			x
28	Lembcke et al. (2020)	x			x		x			x			x			x
29	Passlick et al. (2020)	x			x		x		x				x			x
30	Staub et al. (2021)	x				x		x	x				x			x
31	Wulfert et al. (2021)	x			x			x	x				x			x
		71%	13%	16%	48%	52%	48%	52%	48%	52%	35%	13%	52%	45%	3%	52%

Table 7 (continued)

	Literature	Sampling		Theoretical Lens		Further Application			Clustering Algorithm					
		Random	Selective/ Comprehensive	Yes	No	Clusters	(Arche-)types	None	None	k-medoïds	Multiscape Bootstrap resampling	K-means	qualitative	AHC (Ward)
1	Weking et al. (2020a)		x	x		x	x						x	
2	Tönnissen (2020)	x		x		x	x							x
3	Thiebes et al. (2020)		x	x		x	x					x		x
4	Weking et al. (2020b)		x	x		x	x							x
5	Möller et al. (2020)		x	x				x	x					
6	Hodapp et al. (2019)		x	x		x	x					x		x
7	Fruhwirth et al. (2020)		x	x			x						x	
8	Perscheid et al. (2020)		x	x				x	x					
9	Paukstadt et al. (2019)		x	x				x	x					
10	Ertz et al. (2019)		x		x	x	x			x				
11	Möller et al. (2019)	x		x		x	x					x		x
12	Eickhoff (2017)	x			x	x	x				x			
13	Weking (2018a)		x		x	x							x	x
14	Beinke et al. (2018)		x		x	x	x					x		x
15	Weking (2018b)		x	x		x	x						x	
16	Remane et al. (2017b)		x	x				x	x					
17	Remane et al. (2017a)		x	x				x	x					
18	Täuscher et al. (2017)		x	x		x						x		x
19	Bock & Wiener (2017)		x		x			x	x					
20	Remane et al. (2016)		x	x		x	x					x		x
21	Engelbrecht (2016)		x		x			x					x	
22	Hartmann (2016)	x			x	x	x			x				x
23	Katsma (2010)		x	x			x		x					
24	Nagel et al. (2019)		x	x				x	x					
25	Gimpel et al. (2018)	x		x		x	x							x
26	Nagel et al. (2020)		x	x			x		x					
27	Azkan et al. (2020)		x	x				x	x					
28	Lembcke et al. (2020)		x	x		x	x					x		x
29	Passlick et al. (2020)	x			x	x	x			x				x
30	Staub et al. (2021)		x	x			x		x					
31	Wulfert et al. (2021)	x		x				x	x					
		23%	77%	74%	26%	55%	61%	32%	39%	10%	3%	23%	16%	42%

Table 7 (continued)

		Development Method					Exclusivity			Clustering Tool		
	Literature	Nickerson et al. (2013)	Grounded Theory	Numerical	Multidimensional Scaling	Ad Hoc	Mutual	Partial	None	R	SPSS	None
1	Weking et al. (2020a)	x							x			x
2	Tönnissen (2020)	x						x			x	
3	Thiebes et al. (2020)	x					x				x	
4	Weking et al. (2020b)	x						x				
5	Möller et al. (2020)	x							x			x
6	Hodapp et al. (2019)	x					x				x	
7	Fruhwirth et al. (2020)	x					x					x
8	Perscheid et al. (2020)	x					x					x
9	Paukstadt et al. (2019)	x						x				x
10	Ertz et al. (2019)					x	x			x		
11	Möller et al. (2019)	x					x			x		
12	Eickhoff (2017)	x					x			x		
13	Weking (2018a)	x								x		
14	Beinke et al. (2018)	x					x				x	
15	Weking (2018b)	x						x				x
16	Remane et al. (2017b)	x					x					x
17	Remane et al. (2017a)	x					x					x
18	Täuscher et al. (2017)			x			x					
19	Bock & Wiener (2017)	x							x			x
20	Remane et al. (2016)	x					x				x	
21	Engelbrecht (2016)				x		x				x	
22	Hartmann (2016)			x			x					
23	Katsma (2010)		x						x			x
24	Nagel et al. (2019)	x						x				x
25	Gimpel et al. (2018)	x						x				
26	Nagel et al. (2020)	x						x				
27	Azkan et al. (2020)	x						x				x
28	Lembcke et al. (2020)	x					x			x		
29	Passlick et al. (2020)	x					x					
30	Staub et al. (2021)	x					x					x
31	Wulfert et al. (2021)	x						x				x
		84%	3%	6%	3%	3%	55%	29%	13%	16%	19%	45%

Appendix 2: Definition of taxonomy characteristics

Table 8 summarizes the taxonomy's dimensions and characteristics.

Table 8 Definitions of characteristics

Characteristic	Definition
Dimension 1: Object of Analysis	
Start-Up	The object of analysis is start-ups
Incumbents	The object of analysis is incumbents
No differentiation	The object of analysis does not differentiate between start-ups or incumbents
Dimension 2: Data Collection	
Public Data Analysis	The data are collected primarily through public data analysis
Systematic Literature Review	The data are collected primarily through a systematic review of the literature
Hybrid	The data are collected through mixing public data analysis, literature review, and other methods (e.g., interviews)
Dimension 3: Data Sampling	
Random	The data are sampled randomly
Selective/Comprehensive	The data are sampled either through selection or comprehensively
Dimension 4: Theoretical Lens	
Yes	The business model taxonomy uses a theoretical lens (e.g., business model framework) to analyze the data
No	The business model taxonomy does not use a theoretical lens (e.g., business model framework) to analyze the data
Dimension 5: Development Method	
(Nickerson et al., 2013)	The business model taxonomy is designed using the method of Nickerson et al. (2013)
Numerical	The business model taxonomy is designed numerically through cluster analysis
MDS	The business model taxonomy is designed using multidimensional scaling
Grounded Theory	The business model taxonomy is designed using Grounded Theory
Ad Hoc	The business model taxonomy is designed ad hoc or without a clearly identifiable method
Dimension 6: Industry Scope	
Industry-Specific	The business model taxonomy analyzes a business model in a specific industry
Generic	The business model taxonomy analyzes business model taxonomies without a specific industry
Dimension 7: Technology Scope	
Technology-Specific	The business model taxonomy analyzes business models of a specific technology
Generic	The business model taxonomy does not analyze the business model of a specific technology
Dimension 8: Depth of Analysis	
Narrow	The depth of analysis is narrow, i.e., the dimensions and characteristics are on a detailed level
Wide	The depth of analysis is wide, i.e., the dimensions and characteristics are general and abstract
Dimension 9: Exclusivity	
Mutual	All characteristics in each dimension are mutually exclusive
Partial	Some characteristics in some dimensions are mutually exclusive
None	All characteristics in each dimension are not mutually exclusive
Dimension 10: Visualization	
Morphological Field	The business model taxonomy is visualized as a morphological field (e.g., see Table 3)
Hierarchies	The business model taxonomy is organized in a hierarchy, usually visualized as a tree
Tables/Matrices	The business model taxonomy is visualized as a table or matrix
Dimension 11: Further Application	
Clusters	The taxonomy is used to develop clusters of business models
(Arche-)types	The taxonomy is used to develop archetypes of business models
None	The taxonomy is the final product
Dimension 12: Clustering Tool	
R	Clusters are developed using the statistical programming language R
SPSS	Clusters are developed using SPSS
None	No clusters are developed

Table 8 (continued)

Characteristic	Definition
Dimension 13: Clustering Algorithm	
Agglomerative Hierarchical Clustering (AHC)	The clusters are developed using AHC
K-Means	The clusters are developed using k-means
K-medoïds	The clusters are developed using K-medoïds
Multiscale Bootstrap Resampling	The clusters are developed using MBR
Qualitative	The clusters are developed qualitatively
None	No clusters are developed

Appendix 3: Comparison of meta-dimensions

Theoretical lenses are frequently used to guide business model design. Usually, authors used meta-dimensions in morphological taxonomies and structure dimensions and characteristics inside their conceptual borders. In that sense, they act as a theoretical lens through which the underlying literature-based or empirical data is seen (Niederman & March, 2019). Commonly, authors use business model ontologies from the literature, for example, the *VISOR-Framework* (El Sawy & Pereira, 2013) or the *V^4-Framework* (Al-Debei & Avison, 2010; Al-Debei et al., 2008).

Table 9 shows meta-dimensions from our dataset. We aggregated and synthesized each meta-dimension to a higher-order view to construct a holistic view of business models. We contribute to establishing a comprehensive view of business models and standardizing what meta-dimensions should guide business model taxonomy design. Subsequently, we recommend including five mandatory views: *customer, value proposition, value chain, network,* and *finance.* Depending on the technology or industry domain the business model taxonomy addresses, researchers can add specific views. Examples are the blockchain-specific meta-dimensions in Nagel et al. (2019), such as *blockchain applications*.

Table 9 Synthesis of meta-dimensions into six generalized business model views. The number in the brackets indicate how often the individual dimension occurs in the sample

Business model views	Description	Aggregated meta-dimensions	Exemplary dimensions
Customer	Dimensions addressing customers, their segmentation, channels, and interfaces that they use	Target Customer (3), Strategic Choices, Interface (5), Customer Dimension, Value Delivery (2), Community of different actors	Customer Segment, Market
Value Proposition	Dimensions addressing products, services, and offerings in general	Value Proposition (15), Main Service Functionality, Common Value for all Actors	Key Offering, Vehicle Types, Additional Benefits
Value Chain	Dimensions needed to execute the business model, i.e., activities, resources, or technologies	Value Chain (3), Create Value, Strategic Choices, Value Creation & Delivery, Service Platform (5), Organizing Model (4), Value Delivery (4), Value Creation (5), Value Architecture, Architecture, Key Elements, Value Creation Dimension, Technology and Distribution, Data, Interaction, Common Goal	Key Resources, Data Resources, Platform Type
Network	Dimensions relating to partners, ecosystems, and all elements that have a component with a 3rd party	Value Network (3), Value Creation & Delivery, Organizing Model (4), Key Elements, Service Supplier Identification, Active Shaping of Relationships	Mode of Collaboration, Key Stakeholders
Finance	Dimensions relating to all financial matters	Value Capture (10), Capture Value, Revenue Model (6), Value Finance, Value Capture Dimension, Business Model, Monetization	Revenue Streams, Main Cost, Key Revenue Model, Revenue Source
Technology and/or Industry Specific Views (Optional)	Dimensions conceptualizing elements that are unique to the industry or technology the taxonomy addresses	Platform Characteristics, Smart City Application, Blockchain Application (2), Marketplace, Supply-Side, Demand-Side, Usage of Token	Platform Periphery, Permission Model, Protocol Provider, Marketplace, Supply-Side, Demand-Side

Appendix 4: Details of the structured literature review

In order to provide and synthesize the process of our systematic literature review, we draw on the template as proposed by Schoormann et al. (2021). This template conceptualizes the main components that should be considered during the specification of a search strategy and allows to visually processing the search's configuration (see Fig. 2).

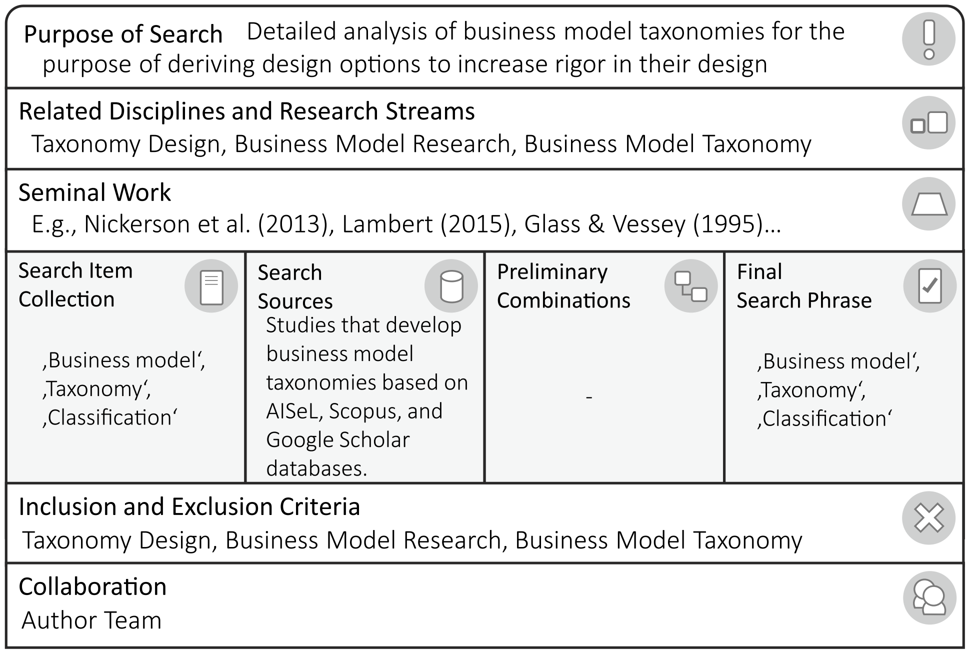


Fig. 2 Exposition of the systematic literature review based on the template of Schoormann et al. (2021)

Appendix 5: Taxonomy development iterations

In the 1st iteration, we deduced dimensions for *visualization*, *depth of analysis*, *industry scope*, and *development method* and formalize the taxonomy as follows:

$T_{\text{1st iteration}} = \{$

D_1 (Visualization) | C_1 (Morphological field, Hierarchy, Mathematical Set, Visual, Table/Matrix, Textual},
D_2 (Depth of Analysis) | C_2 (Narrow, Wide),
D_3 (Industry Scope) | C_3 (Industry-Specific, Generic),
D_4 (Development Method) | C_4 ((Nickerson et al. 2013))}

In the 2nd iteration, the taxonomy has been updated is as follows:

$T_{\text{2nd iteration}} = \{$

D_1 (Visualization) | C_1 (Morphological field, Hierarchy, Mathematical Set, Visual, Matrix/Table, Textual)
D_2 (Exclusivity) | C_2 (Mutual, Partial, None)
D_3 (Depth of Analysis) | C_3 (Narrow, Wide)
D_4 (Industry Scope) | C_4 (Industry-Specific, Generic)
D_5 (Technology Scope) | C_5 (Technology-Specific, Generic)
D_6 (Meta-Dimensions) | C_6 (Yes, No)
D_7 (Development Method) | C_7 (Nickerson et al. (2013), Numerical, MDS, Grounded Theory, Ad Hoc)
D_8 (Data Collection) | C_8 (Public Data Analysis, Literature Review, Hybrid)
D_9 (Data Sampling) | C_9 (Random, Selective/Comprehensive)
D_{10} (Object of Analysis) | C_{10} (Start-Ups, Incumbents, No Differentiation)

D_{11} (Further Application) | C_{11} (Clusters, (Arche-)types, None)
D_{12} (Clustering Tool) | C_{12} (R, SPSS, None)
D_{13} (Clustering Algorithm) | C_{13} (AHC, K-Means, k-medoïds, MRB, Qualitative, None)**}**

In the 3rd iteration, finally, we introduced the notion of exclusivity of characteristics, which we determined for every dimension through discussion amongst the authors. The final taxonomy is as follows:

T_{Final} = {
MD_1 (Data) {

D_1 (Object of Analysis) | C_1 (Start-Ups, Incumbents, No Differentiation) | EX = {N}
D_2 (Data Collection) | C_2 (Public Data Analysis, Literature Review, Hybrid) | EX = {Y}
D_3 (Data Sampling) | C_3 (Random, Selective/Comprehensive) | EX = {Y}
D_4 (Theoretical Lens) | C_4 (Yes, No) | EX = {Y}},

MD_2 (Development) {

D_5 (Development Method) | C_5 (Nickerson et al. (2013), Numerical, MDS, Grounded Theory, Ad Hoc) | EX = {Y}}
D_6 (Industry Scope) | C_6 (Industry-Specific, Generic) | EX = {Y}
D_7 (Technology Scope) | C_7 (Technology-Specific, Generic) | EX = {Y}
D_8 (Depth of Analysis) | C_8 (Narrow, Wide) | EX = {Y}},

MD_3 (Representation) {

D_9 (Exclusivity) | C_9 (Mutual, Partial, None) | EX = {Y}
D_{10} (Visualization) | C_{10} (Morphological field, Hierarchy, Table/Matrix) | EX = {Y}},

MD_4 (Analysis) {

D_{11} (Further Application) | C_{11} (Clusters, (Arche-)types, None) | EX = {N}
D_{12} (Clustering Tool) | C_{12} (R, SPSS, None) | EX = {Y}
D_{13} (Clustering Algorithm) | C_{13} (AHC, K-Means, k-medoïds, MRB, Qualitative, None) | EX = {Y}}}

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